Computer assisted learning: Perceptions and Knowledge Skills of Undergraduate Medical Students in a Malaysian Medical School.

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ABSTRACT

Objective: Medical students often find it difficult to conceptualize the various aspects of pharmacology. Interactive multimedia softwares have been designed in developed countries to demonstrate experiments in pharmacology using virtual animals claiming benefits of the same. Our objective is to find out whether Computer Assisted Learning (CAL) enhances understanding in Malaysian students and to assess their cognitive skills (knowledge acquired and perceptions) with computer simulations in Pharmacology practical experiments.

Methods: One hundred and twenty seven students attended the practicals. They filled a survey questionnaire on the outcomes, advantages and disadvantages of the CAL session using simulations software. They took up tests before and after the CAL session. The data was analyzed using descriptive statistics and proportion test.

Results - The survey in the form of questionnaire indicated that >80% of the students found the simulations to be good and 75% claimed that their understanding had improved. Improvement in the knowledge acquired is reflected in the post test.

Conclusion - Undergraduate medical students find that CAL reinforces the lectures, enriches the learning experience and lets them personalize learning at their own pace within the time-tabled slots.

KEY WORDS: Record Computer-Assisted Learning, Simulated experiments, Pharmacology, Knowledge, Perceptions, thesis, obligation, benefits

Introduction

According Pharmacology is the science of drugs which includes "what the drugs do to the body' and "what the body does to the drug". Practical demonstrations are an integral and essential part pharmacology teaching. Although, the widely used traditional animal based experiments are invaluable, they have several limitations. These include variability in tissue response, intensive labour demand,

availability of the animals, purchase and maintenance cost. Furthermore, difficulty in handling large animals like dogs and cats should also be considered. [1-3]

Introduction of computers in schools has made students receptive to computer- assisted learning (CAL).[4] Various software demonstrating experimental pharmacology are now being used to teach pharmacokinetics, pharmacodynamics, cholinergic and adrenergic effects of drugs, drugs acting on the cardiovascular system, neuromuscular blocking drugs, drugs as anti-inflammatory agents and so on. These softwares mimic the actual experimental set up in the laboratory and help in reinforcing theoretical knowledge of different chemicals (drugs) acting on various systems in the body.[5]

These softwares illustrate methods and choice of anaesthesia, dissection and mounting animal tissues. An interactive interface to study the various effects of different drugs is also included. In addition, this comprehensive interface provides interactive instructions and multiple choice questions for self-assessment. Furthermore, the role of CAL is not only restricted to the animal experiments but also promotes rational and evidence based medical care and medication use through internet.[4,6]

The purpose of this study is to evaluate the students' knowledge acquired, to assess the views of students on CAL in pharmacology practicals and the practical considerations on the use of CAL to demonstrate the effects of drugs. The paper also aims to find out if the medical students from a Malaysian university find CAL as a useful learning medium.

Materials and Methods

A hundred and twenty – seven students took part in the study. The procedures were explained to them and informed consent was obtained from all of them. A pre-test was conducted in the form of MCQs after interactive lecture sessions prior to the practical experiment. During the practical session, students worked in pairs on a computer while performing the experiment. Handouts with detailed learning objectives were given to the students. Four members of academic staff were present to provide guidance throughout the three hour practical class. The Compact Disc Read - Only Memories (CD-ROMs) for the practical experiments were obtained from Sheffield University Bioscience program to demonstrate the actions of drugs acting on the autonomic nervous system to Year

1 medical students. The computer simulated experiments had different sections which included

a) Description of the choice of animals

b) Common equipments used for the demonstration of the experiments

c) Choice of anaesthesia

d) Interactive section on drugs, their agonists and antagonists in relation to parameters like heart rate, blood pressure, and coronary flow and so on.

e) At the end of the experiments, interactive section on multiple choice questions

At the end of the practical session, a post-test was conducted in the form of MCQs to access the knowledge skills acquired from CAL.

To examine the perceptions of students towards CAL, a feedback questionnaire which tested the effectiveness and ease of performing the experiments was given to them.

The questionnaire had the three following sections:

1. The outcomes of computer simulated pharmacology experiments

2. Advantages of computer simulated pharmacology experiments

3. Disadvantages of computer simulated experiments in pharmacology.

The participants had the option to remain anonymous and were informed that the survey was not related to their continuous assessment or end-block assessment.

Statistical analysis: The data was analyzed using descriptive statistics and two-sample z-test (proportion test). The data from the pre-test and post-test was to be compared and the significance of the difference in the percentage pass was to be worked out by finding the "p" value.

Results

Results on knowledge assessment

Evaluation was done by the way of pre and post tests comprising objective type MCQs. The number of students, percentage pass and average score are shown in Table 1. One hundred and twenty seven students took the pre test out of which one hundred and five

students (82%) performed with an average score of 64.36%. (Table 1). After the CAL Practical experiment, one hundred and twenty six students took the post test and one hundred and seventeen performed with an average score of 75.41%. (Table 1) Statistical analysis using a proportion test for pre and post tests showed a p-value of 0.0145 indicating that there was a significant increase in the knowledge acquired after the CAL practical session.

Table 1: Assessment of knowledge acquired (Pre-test and Post-test results). (n= 127)

| Scores	Average (%)	Standard deviation (%)	No. of passes (n)	Percentage pass (%)	Total number of students (n)
Pre-test	64.36	18.04	105	82	127
Post-test	75.41	17.09	117	92	126

P value = 0.0145

Results on perceptions of students on CAL

The results from the feedback questionnaire are shown in bar charts as in Figures 1, 2 and 3

The outcomes of CAL in pharmacology experiments reveal that 83.3% of students felt that the overall simulations were good and written instructions for CAL were helpful. 75% claimed that their understanding had improved and had enjoyed using CAL. Nearly 70% felt that they had achieved the learning objectives and prefer simulations to live animal experiments and recommend CAL to others.

Figure 1: The outcomes of computer simulated pharmacology experiments.
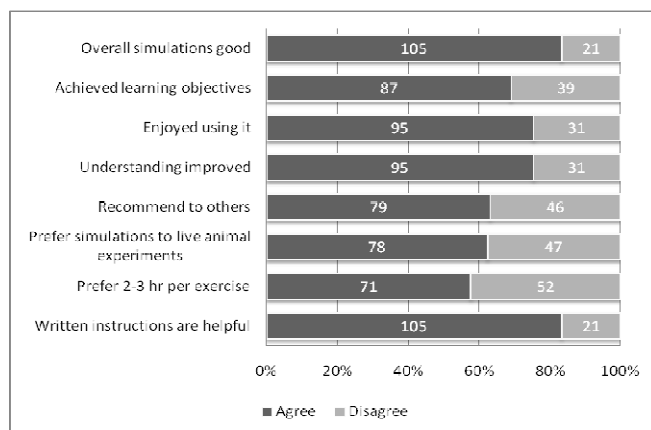

The advantages described by the students are shown in Figure 2. More than 80% of students felt that complicated procedures in live animals could be demonstrated and observed easily in virtual animals 90 % of the students felt that they could repeat, pause and resume the experiments without any loss of animals. > 70% expressed that the drugs' effects could be visualized clearly with no experimental errors.

Figure 2: Advantages of Computer Simulated Pharmacology Experiments
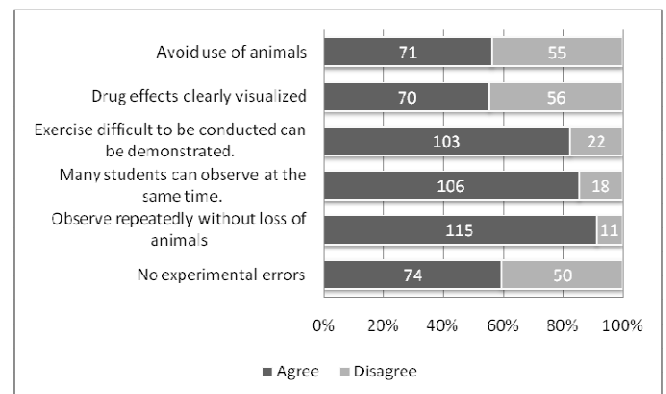
The short comings of CAL as felt by the students are shown in Figure 3. More than 80% of students had pointed out that the actual hands-on experience with animals was lost, live interaction was absent and that biological variations seen in living tissues could not be observed. They have also said that the doses of drugs were prefixed in the experiments. 50% of them felt that computer expertise is needed to counter the technical snags. 30% thought that computer simulated experiments was an expensive way of learning.

Figure 3: Disadvantages of Computer Simulated Pharmacology Experiments
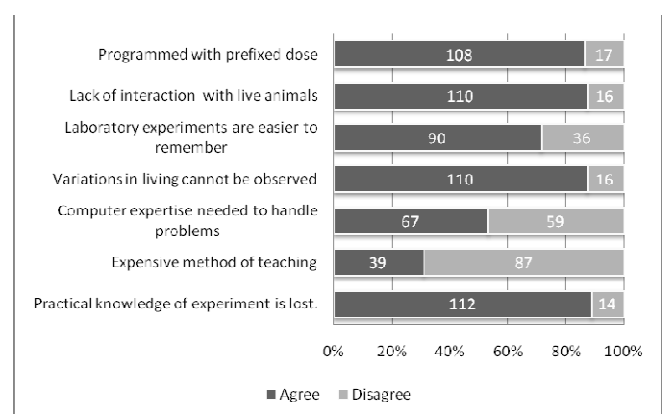
Discussion

It is said that discussion is an exchange of Adopting diversity in teaching approaches and learning environment is essential for effective practical lessons in pharmacology. Software development for practical experiments, educational workshops and training has been on the rise in Asian Universities in tandem with the developed countries. Lecturers in Pharmacology have been improvising the teaching methods with integrated teaching.[1-5] Traditional schools are changing to integrated teaching methods and one such approach is the CAL practicals.[5] Teaching pharmacology in dry practicals has employed the use of CDRoms to teach the various systems in the body.[6-8] In this study, the results of the questionnaire elucidate that students appreciate and support computer assisted learning experiments. Students have indicated that CAL makes them understand better the theoretical aspects of pharmacology and helps them fulfil the learning outcomes.

CAL, facilitates the student to learn at his/her own pace, pause, repeat and resume the steps for studying the responses to a particular drug. This fact is of special advantage to the slow learners, which has been observed in this study and also by other researchers.[9,10] Reproducibility is a problem with biological animal experiments. This may change the students' perception of their own rate of learning. Discouragement and loss of time encountered in animal experiments due to biological variations is overcome by simulated experiments.[1] Computer assisted learning resolves these issues effectively and reduces the need for animal experiments which are labour intensive and expensive. From studies carried out elsewhere, it has been found that simulated practicals prove to be cost-effective than establishing and maintaining animal houses when it comes to limited resources and manpower.[4,6,11,12] Research has also shown a downward trend in the use of animals for experiments in basic sciences over the years.[4,9,14] Some students have expressed that technical expertise is needed to attend the technical snags encountered during the computer assisted learning sessions. Good IT support precludes any such technical glitches in any institution.

Unfortunately, most of the experiments consist of agonists, antagonists to receptors, second messenger signalling, action potentials, actions of ions and so on which are difficult to conceptualize in live animals. In this study we see that students agree that computer simulations helped them visualize the drug responses clearly. The disadvantages mentioned by the students include lack of actual experience with animals and the experiment being programmed with prefixed dose. The students are not expected to master psychomotor skills at this stage. Nevertheless they can acquire surgical skills during their clinical postings. The students in the preclinical years are expected to observe, interpret, apply the knowledge acquired through lectures and Self Directed Learning.[8] Another issue raised by students is that simulated experiments demonstrate only prefixed doses. The reason for the prefixed doses is to stress on the specific pharmacological actions of drugs on receptors.

An objective assessment of factual and conceptual understanding was done by pre and post tests, before and after the CAL practicals. A definite increase in understanding the subject and knowledge acquired by the students was observed in this study which was reflected in the improvement in performance in the post-test result.

Limitations of this study include no direct interaction with living tissues, requirement of expertise in computer technology to fix any computer related issues and the high cost of initial installation of computerized laboratories and simulated softwares.

Conclusions

Computer assisted learning in experimental pharmacology plays a pivotal role in the scholastic achievement of students by helping them develop a positive attitude towards basic sciences. In our study we found that computer based experiments helped students recollect and apply the theoretical knowledge of drugs to the practical sessions. We would like to add that computer simulations let students to learn at their own pace and that CAL effectively complements lectures.

We suggest that CAL can be seamlessly blended with lectures and tutorials to have an eclectic learning and teaching experience to students and teachers. In addition, computer assisted learning can help teachers and students link with learned societies using CAL and the internet and widen the horizons of learning.

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